3.1 Quadratic Functions and Applications

Parabolas: the graphs of all quadratic functions; they are cup-shaped and symmetric with respect to a vertical line (**Axis of Symmetry**).
Vertex (Turning Point): the minimum or maximum point of a parabola
Axis of Symmetry: a vertical line $\left(x = \quad\right)$ that passes through the vertex.

❖ Quadratic Function in Standard Form (Vertex Form)

$$f(x) = a(x-h)^2 + k$$

To graph $f(x) = a(x-h)^2 + k$:

➔ need 5 ordered pairs

- **Vertex:** (h, k)
- **Axis of symmetry:** $x = h$
- For $a > 0$, the parabola opens upward. (h, k) is a minimum point.

  For $a < 0$, the parabola opens downward. (h, k) is a maximum point.
- ***x*-intercepts:** set $a(x-h)^2 + k = 0$ and solve x by square root property.
- ***y*-intercepts:** plug 0 into x and solve for *y*.
- Graph: connect points with a smooth curve.

❖ Quadratic Function in General Form

$$f(x) = ax^2 + bx + c$$

To graph $f(x) = ax^2 + bx + c$**:**

- Axis of Symmetry: $x = -\dfrac{b}{2a}$
- Vertex: $\left(-\dfrac{b}{2a}, f\left(-\dfrac{b}{2a}\right)\right)$ $\Longrightarrow$ plug *x* value back to the original function to find *y*.
- For $a > 0$, the parabola opens upward. (h, k) is a minimum point.
- For $a < 0$, the parabola opens downward. (h, k) is a maximum point.
- ***x*-intercepts:** set $ax^2 + bx + c = 0$ and solve x by factoring, quadratic formula, or completing the square.
- ***y*-intercepts:** plug 0 into x and solve for *y*. $(0, c)$
- Graph: connect points with a smooth curve.

Ex. Given $g(x)=\frac{1}{2}(x+2)^2$.

(a) Determine, without graphing, whether the function has a minimum value or a maximum value.

$a=$_______.

The parabola opens __________ and has a _____________ value.

(b) Find the minimum or maximum value and determine where it occurs.

The _____________ is _________ at $x=$_____.

(c) Identify the function's domain and its range.

Domain: ______________

Range: ________________

Ex. Given $f(x)=-2x^2-12x+3$.

(a) Determine, without graphing, whether the function has a minimum value or a maximum value.

$a=$_______.

The parabola opens __________ and has a _____________ value.

(b) Find the minimum or maximum value and determine where it occurs.

The _____________ is _________ at $x=$_____.

(c) Identify the function's domain and its range.

Domain: ______________

Range: ________________

Ex. (#45) A long jumper leaves the ground at an angle of 20° above the horizontal, at a speed of 11 *m*/*sec*. The height of the jumper can be modeled by $h(x) = -0.046x^2 + 0.364x$, where *h* is the jumper's height in meters and *x* is the horizontal distance from the point of launch.

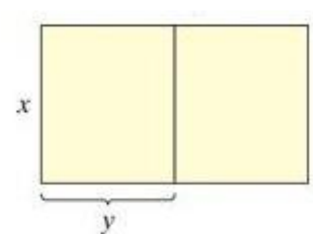
(a) At what horizontal distance from the point of launch does the maximum height occur? Round to 2 decimal places.

(b) What is the maximum height of the long jumper? Round to 2 decimal places.

(c) What is the length of the jump? Round to 1 decimal place.

Ex. (#54) Two chicken coops are to be built adjacent to one another from 120 ft of fencing.

(a) What dimensions should be used to maximize the area of an individual coop?



(b) What is the maximum area of an individual coop?